RESPONSE OF BARLEY CULTIVARS TO PLANT GROWTH REGULATORS

F.A. Holm and E.F. Partyka
Department of Crop Science and Plant Ecology
University of Saskatchewan, Saskatoon

INTRODUCTION

Lodging in barley can cause poor filling of barley heads leading to yield losses. Also harvesting a badly lodged barley crop can be difficult. Conditions such as good moisture and high fertility can lead to increased barley yields, however increased yields result in increased weight of individual inflorescences. Consequently, full yield potential can only be obtained if the culm is strong enough to carry the extra weight. If lodging occurs early, there may be some recovery because the nodes retain their meristematic activity and asymetric growth of the internode base makes the plant grow upright. Late lodging will present more severe harvesting problems because the plants do not have an opportunity to recover.

Plant growth regulators can strengthen and shorten the straw which can reduce lodging. Cerone, a 400 g/L solution of ethephon is currently registered and commercially available to growers. Terpal C, a formulated mixture of CCC at 305 g/L and 155 g/L of ethephon, is not registered for barley however the manufacturer has submitted for registration and it is possible it could be available to growers in the future. The objective of this study was to investigate the effectiveness of these 2 products in controlling lodging in barley under dryland and irrigated conditions.

METHODS AND MATERIALS

The trials were conducted over the 1986 and 1987 growing seasons under dryland and irrigated conditions. All dryland tests were conducted in the thin black soil zone in the Speers area and all irrigated tests were conducted at the Irrigation Development Centre at Outlook, Saskatchewan. Barley varieties under irrigation in 1986 were Bonanza, Johnston and Leduc and in 1987 they were Leduc, Virden and Johnston. Varieties tested under dryland conditions in 1986 were Johnston and Bonanza, while in 1987 they were Johnston and Leduc. The chemicals tested were ethephon (Cerone TM) at 2 rates; 0.24 kgai/ha and 0.40 kgai/ha and a formulated mixture of ethephon + CCC (Terpal C TM) at 2 rates; 0.46 kgai/ha and 0.69 kgai/ha. Each rate of each chemical was tested at 2 growth stages. An early timing (Zadok's early-30's) and a late timing (Zakok's mid-40's). Cittowet Plus wetter and sticker was used with all Terpal C treatments at a concentration of 0.05% V/V. All chemical treatments were applied in 110 L/ha of water at 275 kPa pressure using a hand held boom sprayer equipped with six 8001SS Teejet nozzles spaced 50 cm apart and set 50 cm above the crop. High fertility levels were used in an attempt to induce lodging. For example, dryland tests had in excess of 130 kg/ha of nitrogen applied and all irrigated tests in excess of 200 kg/ha of nitrogen applied. Experimental design was a randomized complete block with 4 replications and plot size was 3 meters wide by 6 meters long. Statistical analysis was done on all data collected except for visual assessments. If significance was determined for treatment effects, comparisons of means

were made using Fisher's protected T-test at P=0.05. Yields were estimated by harvesting a 7.8 m^2 portion of each plot with a mechanical small plot harvester. Visual ratings for lodging were conducted near harvest by estimating the surface area lodged on a 1 to 9 scale, 1 representing no lodging and 9 representing the total plot area being lodged. Lodging intensity was estimated using a 1 to 5 scale, 1 representing completely upright and 5 representing a completely flattened crop. Delays in maturity were estimated in days and phytotoxicity was assessed using the ECW 0 to 9 scale, 0 representing complete crop destruction and 9 representing no noticeable effects.

RESULTS AND DISCUSSION

Lodging was noticed in all irrigated trials and no significant lodging was observed in dryland trials. There was a significant yield response to PGR use in all irrigated trials except for Virden in 1987. The extra yield in these trials came from reduced lodging, which also made the crop easier to harvest. Yield information is given in Table 1. Yield differences in those tests where lodging occurred may have been exaggerated because the plots were straight combined and it was not possible to harvest all the crop laying on the ground in the badly lodged plots, particularly in the 1986 experiments. Visual lodging ratings taken close to harvest are reported in Table 2. Ethephon at the high rate and later timing gave the best protection against lodging. All early applications did not provide sufficient protection against lodging when assessed visually even though they yielded significantly more than the untreated control. Both rates of Terpal C applied late gave good control of lodging, however it was not always complete control. All treatments significantly reduced crop height, however the high rates and late timings shortened the crop the most. Crop heights near harvest are given in Table 3. Phytotoxic effects included delayed maturity and head blasting in irrigated tests in 1986. Delay in maturity generally was longest with the higher rates and later timings of the PGRs. Estimated delays in maturity are reported in Table 4. Head blasting was seen only in irrigated tests in 1986 and the visual estimates are given in Table 5.

SUMMARY

1. Cerone and Terpal C can provide reasonably good control of lodging in barley if applied at GS mid-40's. However, the higher rate of application may be necessary to give acceptable protection against lodging where lodging pressure is severe.

2. Phytotoxic effects of both Terpal C and Cerone include delays in maturity and head blasting under certain conditions.

3. Yield benefits reported in this study due to reductions in lodging might be exaggerated because the plots were straight combined and any of the crop below the cutter bar was not harvested. In a farm situation, a swather equipped with lifter guards and/or a pick-up reel could have recovered a higher proportion of the crop.

Table 1. Effect of rate and time of application of ethephon and ethephon + CCC on grain yield of barley.

Treatment	Rate kgai/ha	ZGS timing	1986 Irrigated Bonanza	1986 Irrigated Leduc	1986 Irrigated Johnston	1986 Dryland Bonanza	1986 Dryland Johnston	1987 Irrigated Johnston	1987 Irrigated Leduc	1987 Irrigated Virden	1987 Dryland Johnston	1987 Dryland Leduc
Ethephon	0.240	Early 30's	N/A[2]	5600 cd[3]	5170a	4590	4930	4490d	4530ac	5750	3290	3090
Ethephon	0.400	Early 30's	N/A	4610de	5620a	4740	5140	4600d	4450bd	5660	3230	3100
Ethephon[1] + CCC	0.155 +0.305	Early 30's	N/A	4760de	4780a	4800	5130	4370d	4420cd	5730	3350	3110
Ethephon + CCC	0.233 +0.457	Early 30's	N/A	4500e	5280a	4750	4770	4510d	4550ac	5640	3360	3120
Ethephon	0.240	Mid 40's	4580a	6100bc	4590a	4550	5030	4961bc	4650ac	5890	3210	3080
Ethephon	0.400	Mid 40's	5190a	7020ab	5380a	4920	4440	5250a	4790a	6020	3410	3130
Ethephon +CCC	0.155 +0.305	Mid 40's	3980a	7410a	4880a	4640	4710	4890c	4350ac	5890	3320	3170
Ethephon +CCC	0.233 +0.457	Mid 40's	5320a	6470ab	4870a	4710	4630	5140ab	4740a	5930	3260	3130
Untreated	-		2220b	3240f	2440b	5360	5640	3940e	4150d	5060	3380	3170
						nsf	nsf			nsf	nsf	nsf

1. Applied as a formulated mixture. Cittowet Plus sticker/wetter used at 0.05% v/v.
2. Not applied.
3. Means in the same column followed by the same letter do not differ significantly at P=0.05.

Table 2. Effect of rate and time of application of ethephon and ethephon + CCC on lodging control in barley

Treatment	Rate kgai/ha	ZGS timing	1986 Bonanza Intensity	1986 Bonanza area	1986 Johnston Intensity	1986 Johnston area	1986 Leduc Intensity	1986 Leduc area	1987 Johnston Intensity	1987 Johnston area	1987 Leduc Intensity	1987 Leduc area	1987 Virden Intensity	1987 Virden area
Ethephon	0.240	Early 30's	N/A[2]		3.3	5.8	3.8	8.0	3.8	4.3	2.3	2.8	2.3	3.8
Ethephon	0.400	Early 30's	N/A		2.3	4.8	4.0	8.0	3.5	3.3	2.5	2.3	1.8	2.3
Ethephon[1] +CCC	0.155 +0.305	Early 30's	N/A		2.8	5.5	3.8	8.3	4.5	4.0	2.5	3.0	3.5	3.3
Ethephon +CCC	0.233 +0.457	Early 30's	N/A		2.5	4.0	3.8	7.5	4.3	3.5	2.3	2.5	2.5	2.8
Ethephon	0.240	Mid 40's	2.3	4.8	3.3	5.0	1.8	2.5	2.0	2.3	1.8	2.0	1.3	2.0
Ethephon	0.400	Mid 40's	1.0	1.0	1.8	2.3	1.8	1.5	1.8	1.5	1.0	1.0	1.0	1.0
Ethephon +ECC	0.155 +0.305	Mid 40's	2.5	5.0	2.0	3.0	2.5	2.3	2.3	2.5	2.3	2.5	1.8	2.3
Ethephon +CCC	0.233 +0.457	Mid 40's	1.5	2.0	1.0	1.0	2.0	1.5	2.0	1.3	1.5	1.3	1.5	1.5
Untreated	-		4.3	8.0	4.8	7.8	5.0	8.8	4.0	5.3	3.8	4.3	3.8	4.5

1. Applied as a formulated mixture. Cittowet Plus sticker/wetter used at 0.05% v/v.
2. Not applied.

Table 3. Effect of rate and time of application of ethephon and ethephon + CCC on height of barley.

Treatment	Rate kgai/ha	ZGS timing	1986 Irrigated Bonanza	1986 Irrigated Leduc	1986 Irrigated Johnston	1986 Dryland Johnston	1987 Irrigated Johnston	1987 Irrigated Leduc	1987 Irrigated Virden	1987 Dryland Johnston	1987 Dryland Leduc
Ethephon	0.240	Early 30's	NA[2]	105ab[3]	113bc	115b	109ad	97b	103b	64bc	58bc
Ethephon	0.400	Early 30's	NA	103bc	111cd	115b	107cd	95bc	101bc	65ab	57cd
Ethephon[1] +CCC	0.155 +0.305	Early 30's	NA	105ab	116b	111bc	111a	96bc	102bc	65ab	59ab
Ethephon +CCC	0.233 +0.457	Early 30's	NA	100cd	114bc	106d	109ac	96bc	104b	66ab	57cd
Ethephon	0.240	Mid 40's	127b	103bc	116b	107d	105d	92d	97d	61de	53ef
Ethephon	0.400	Mid 40's	127b	98d	109d	107d	98e	89e	95d	59e	52f
Ethephon +CCC	0.155 +0.305	Mid 40's	128b	99cd	109d	109cd	108bd	94c	100c	62cd	55de
Ethephon +CCC	0.233 +0.457	Mid 40's	127b[3]	98d	105e	106d	101e	92e	96d	60de	51f
Untreated	-		141a	109a	121a	120a	111ab	100a	111a	68a	60a

1. Applied as a formulated mixture. Cittowet Plus sticker/wetter used at 0.05% v/v.
2. Not applied.
3. Means in the same column followed by the same letter do not differ significantly at P=0.05.

Table 4. Effect of rate and time of application of ethephon and ethephon + CCC on time to maturity of barey.

Treatment	Rate kgai/ha	ZGS timing	1986 Irrigated Bonanza	1986 Irrigated Leduc	1986 Irrigated Johnston	1986 Dryland Bonanza	1986 Dryland Johnston	1987 Irrigated Johnston	1987 Irrigated Leduc	1987 Irrigated Virden	1987 Dryland Johnston	1987 Dryland Leduc
Ethephon	0.240	Early 30's	NA	2.8	1.5	2.0	2.0	1.8	2.0	1.0	1.0	1.0
Ethephon	0.400	Early 30's	NA	2.3	1.5	2.5	1.8	2.0	1.8	1.8	1.0	1.3
Ethephon[1] +CCC	0.155 +0.305	Early 30's	NA	2.8	2.0	2.8	2.0	1.3	2.3	2.3	2.8	2.3
Ethephon +CCC	0.233 +0.457	Early 30's	NA	1.8	2.0	2.5	2.5	3.0	2.8	2.8	2.3	2.8
Ethephon	0.240	Mid 40's	2.8	4.8	2.8	3.0	2.3	2.3	2.8	3.0	3.0	3.3
Ethephon	0.400	Mid 40's	3.3	4.8	3.5	4.0	3.0	3.8	3.8	3.3	3.0	3.8
Ethephon +CCC	0.155 +0.305	Mid 40's	3.3	3.8	3.0	3.8	3.5	4.0	3.3	4.3	3.3	4.0
Ethephon +CCC	0.233 +0.457	Mid 40's	4.0	4.8	3.5	4.3	3.3	4.0	4.3	4.8	3.0	3.8
Untreated	-		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

1. Applied as a formulated mixture. Cittowet Plus sticker/wetter used at 0.05% v/v.
2. Not applied.

Table 5. Phytotoxic effects of rate and time of application of ethephon and ethephon + CCC on barley.

Treatment	Rate kgai/ha	ZGS timing	Irrigated (1986) Bonanza	Leduc	Johnston
Ethephon	0.240	Early 30's	NA[2]	7.8	9.0
Ethephon	0.400	Early 30's	NA	7.3	8.3
Ethephon [1] +CCC	0.155 +0.305	Early 30's	NA	7.5	9.0
Ethephon +CCC	0.233 +0.457	Early 30's	NA	7.8	8.5
Ethephon	0.240	mid 40's	8.8	7.8	9.0
Ethephon	0.400	mid 40's	7.3	7.3	8.3
Ethephon +CCC	0.155 +0.305	mid 40's	9.0	8.0	8.8
Ethephon +CCC	0.233 +0.457	mid 40's	8.3	7.5	8.5
Untreated	-		9.0	9.0	9.0

1. Applied as a formulated mixture. Cittowet Plus sticker/wetter used at 0.05% v/v.

2. Not applied.